

CERTS Microgrid Concept and The Role of Storage

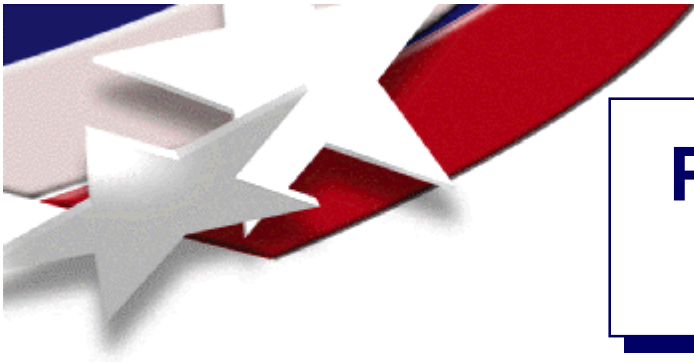
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Consortium for Electric Reliability Technology Solutions (CERTS)

- ◆ Formed in 1998 to research, develop, and commercialize new methods, tools, and technologies to protect and enhance the reliability of the U.S. electric power system under the emerging competitive electricity market structure.
- ◆ Conducting research for the U.S. Department of Energy Transmission Reliability Program and for the California Energy Commission Public Interest Energy Research program.
- ◆ Researchers are Lawrence Berkeley National Laboratory, Electricity Markets and Policy Group, Oak Ridge National Laboratory Power Systems Research Group, the Pacific Northwest National Laboratory, Power Systems Engineering Research Center, Sandia National Laboratories and Southern California Edison Company.



Present State of Distributed Generation

- ◆ Technologies
 - ❖ Micro-turbines
 - ❖ Energy Storage
 - ❖ Wind
 - ❖ *Fuel cells*
- ◆ Applications
 - ❖ Single/multiple units
 - ❖ Small to large industrial user sites
 - ❖ Stand-alone or grid interconnected
- ◆ Penetration Impact
 - ❖ Low



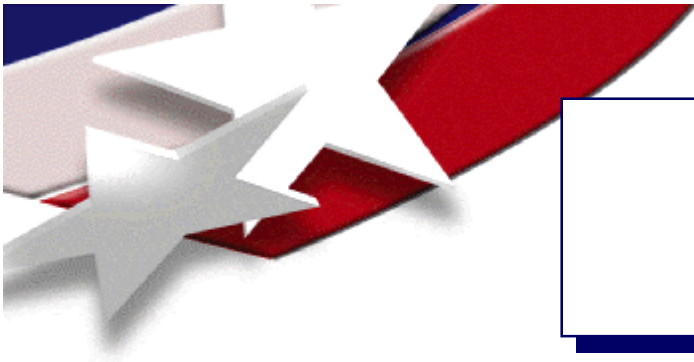
Future Vision of Distributed Generation

- ◆ Significant penetration
 - ❖ 20% of new capacity additions
- ◆ Diverse generation technologies
- ◆ Enhances grid reliability
- ◆ Market participation
- ◆ Combined heat and power



Drawback of Individual Unit Installations

- ◆ Centralized control and dispatch of individual units is impractical
 - ❖ ISO/RTO perspective
- ◆ Contribution to grid reliability is unlikely
- ◆ Cannot be a market participant (for 1st. Generation machines)



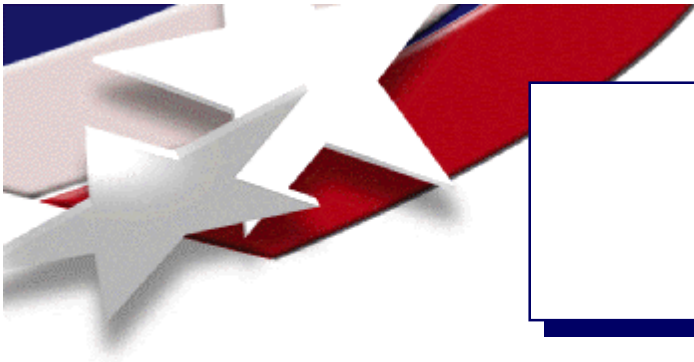
The Microgrid Concept

- ◆ “Microgrid” as a term has been widely used but seldom described in detail
 - ❖ Control and operation, optimized generation mix, economics,
- ◆ An aggregation of micro-sources, generation and storage, serving multiple customers
- ◆ Presents itself as a single operating entity to the grid
- ◆ No centralized individual control or dispatch
 - ❖ “Plug & Play” model



Microgrid Characteristics

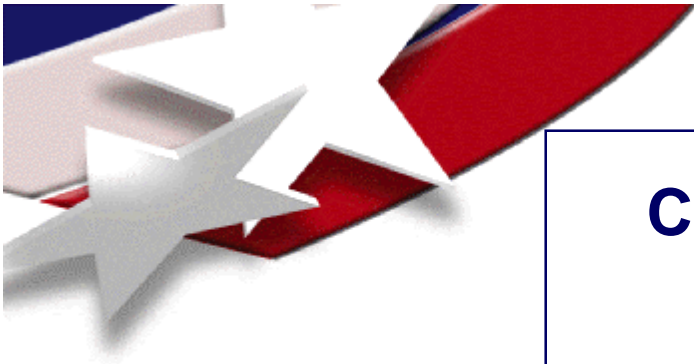
- ◆ Individual power sources < 100 kW
- ◆ Aggregate power capacity - 10 MW
- ◆ Standardized power electronics interface
 - ❖ Control and communication with grid
- ◆ Low voltage 480 - 120 V connection to local customer
- ◆ Power parks become a subset of microgrids



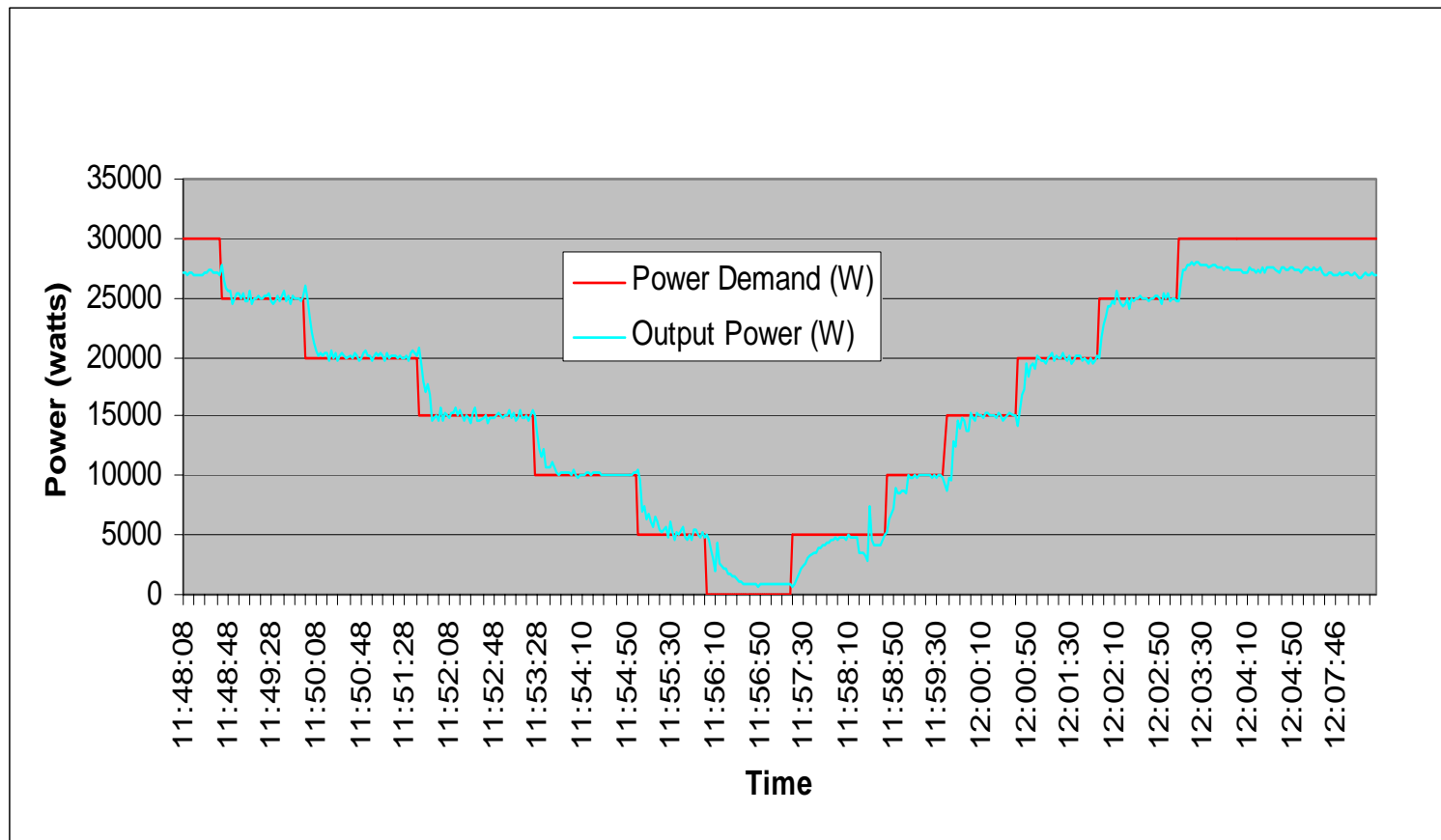
Why Storage?

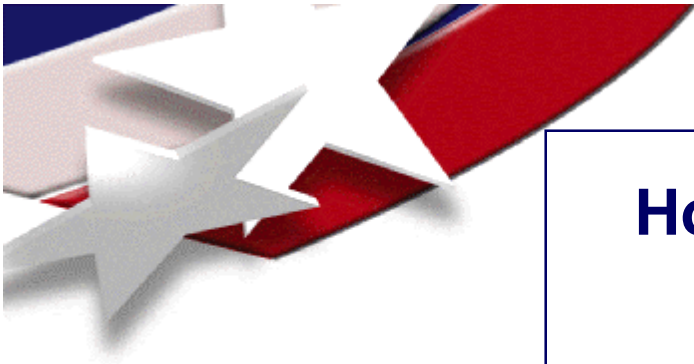
- ◆ Present systems - microturbines and fuel cells - have poor load following characteristics
 - ❖ Step load changes
 - ❖ Inability to start motor loads

- ◆ Cannot transition from grid connected to stand-alone mode without shutdown
 - ❖ Storage makes the transition possible for microgrids
 - ❖ Honeywell and Capstone microturbines

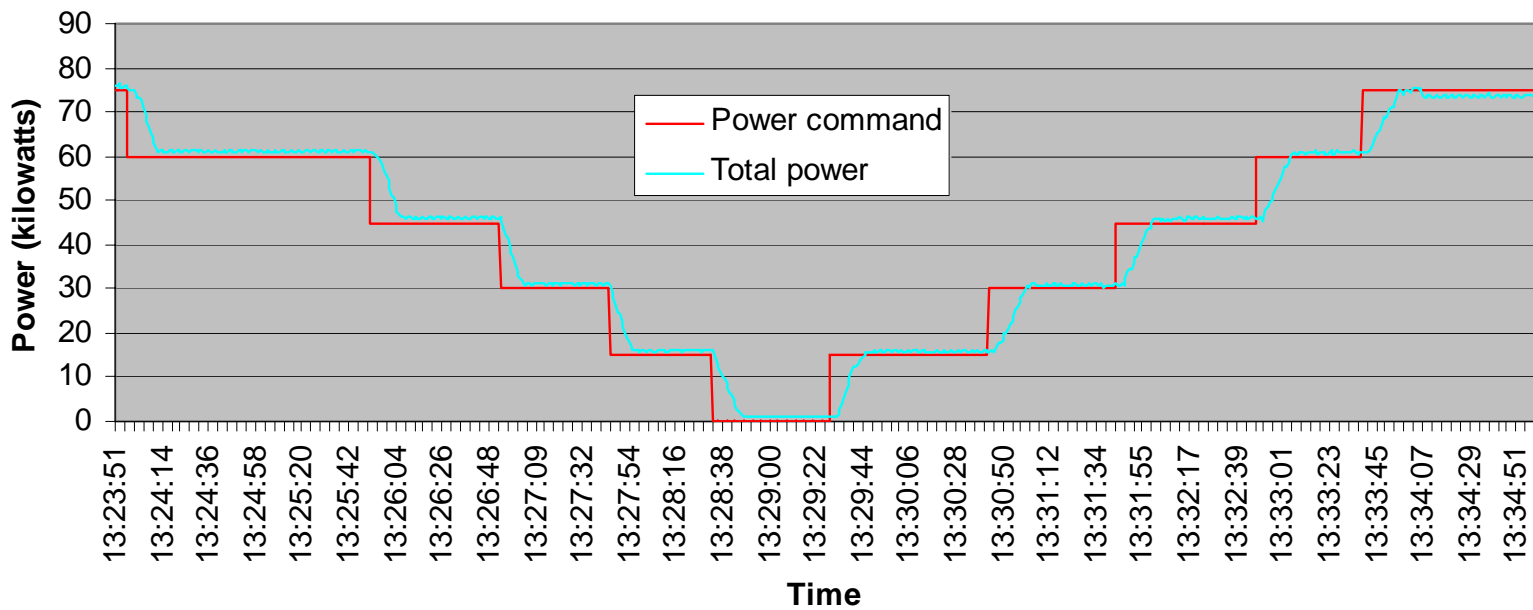


Capstone 28 kW Microturbine Grid Connected





Honeywell 75 kW Microturbine Grid Connected





Types of Storage

- ◆ On-board storage
 - ❖ Integrated into the microturbine or fuel cell
 - ❖ 5 minutes, <100 kW

- ◆ Traditional storage
 - ❖ Integrated into the microgrid
 - ❖ Provides a transition from grid-connected to stand-alone and vice versa
 - ❖ Capable of sub-cycle transition, providing a reference for other generation sources to follow
 - ❖ 5 - 15 minutes, up to 10 MW, depending on size of microgrid